

Geologic Characterization of the South Georgia Rift Basin for Source Proximal CO₂ Storage

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University of South Carolina - Columbia



Regional Carbon Sequestration Partnerships
Annual Review Meeting
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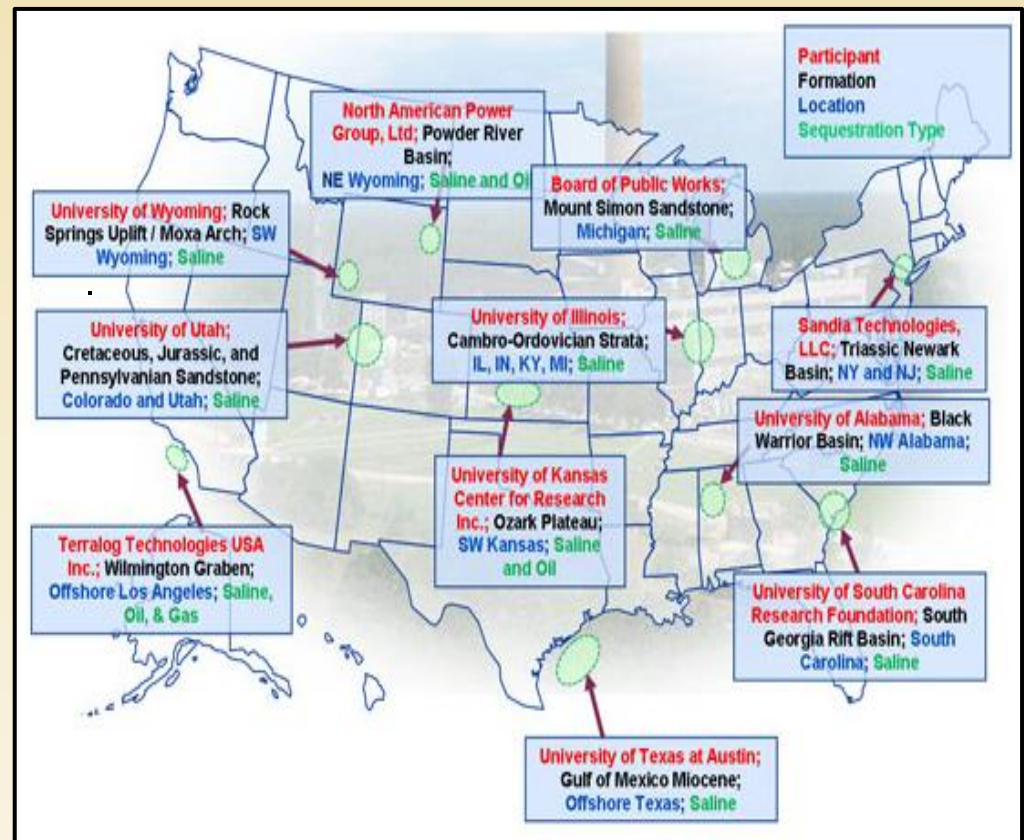
Sponsor

U.S. Department of Energy, National Energy Technology Laboratory “Site Characterization of Promising Geologic Formations for CO₂ Storage”

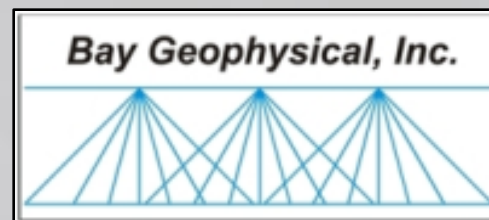


December 8, 2009 through December 7, 2011
\$9,950,639 DOE/NETL Award

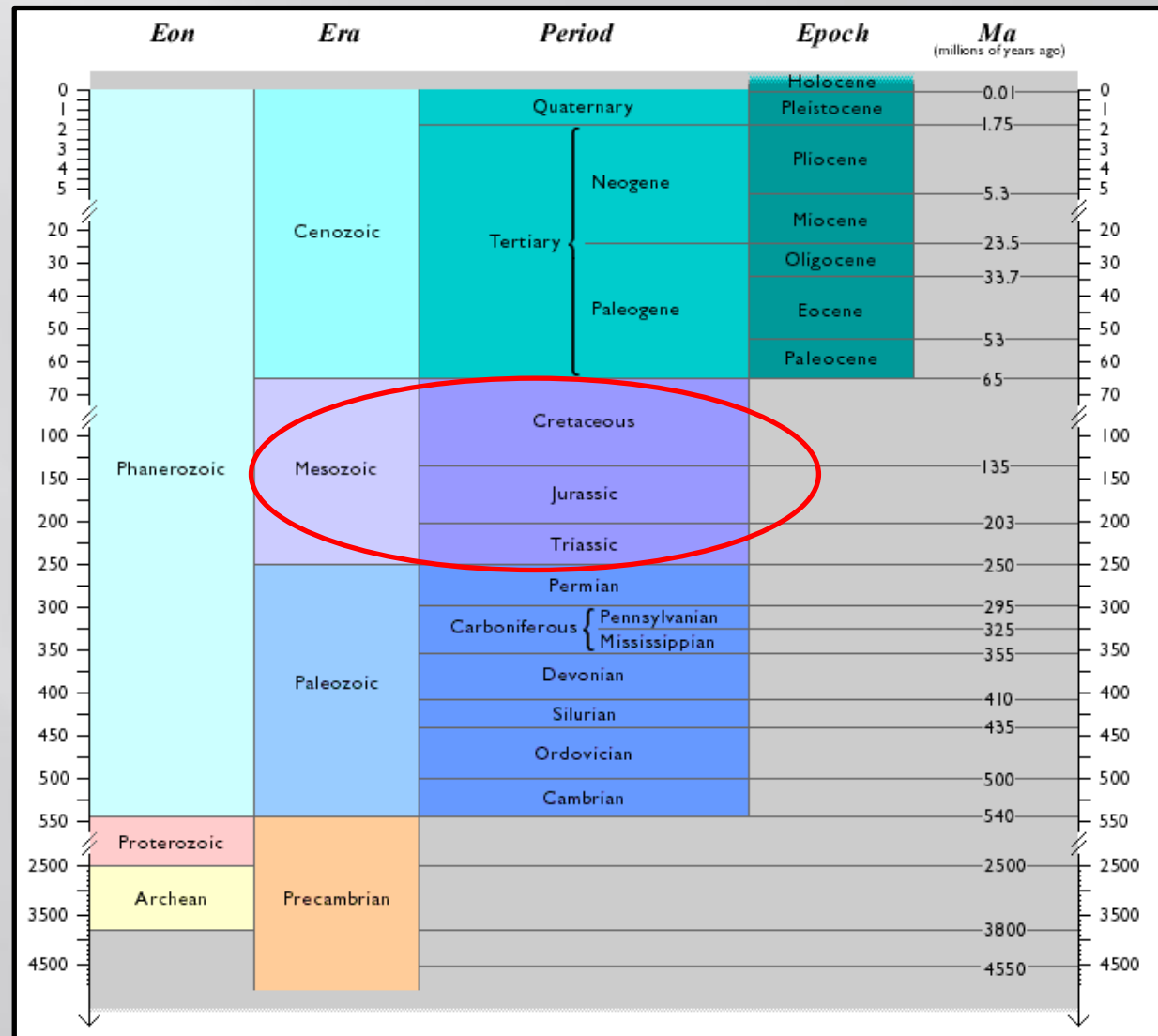
The Department of Energy is funding 10 projects valued at \$125.5 million aimed at increasing scientific understanding about the potential of promising geologic formations to safely and permanently store carbon dioxide.



South Carolina Research Team

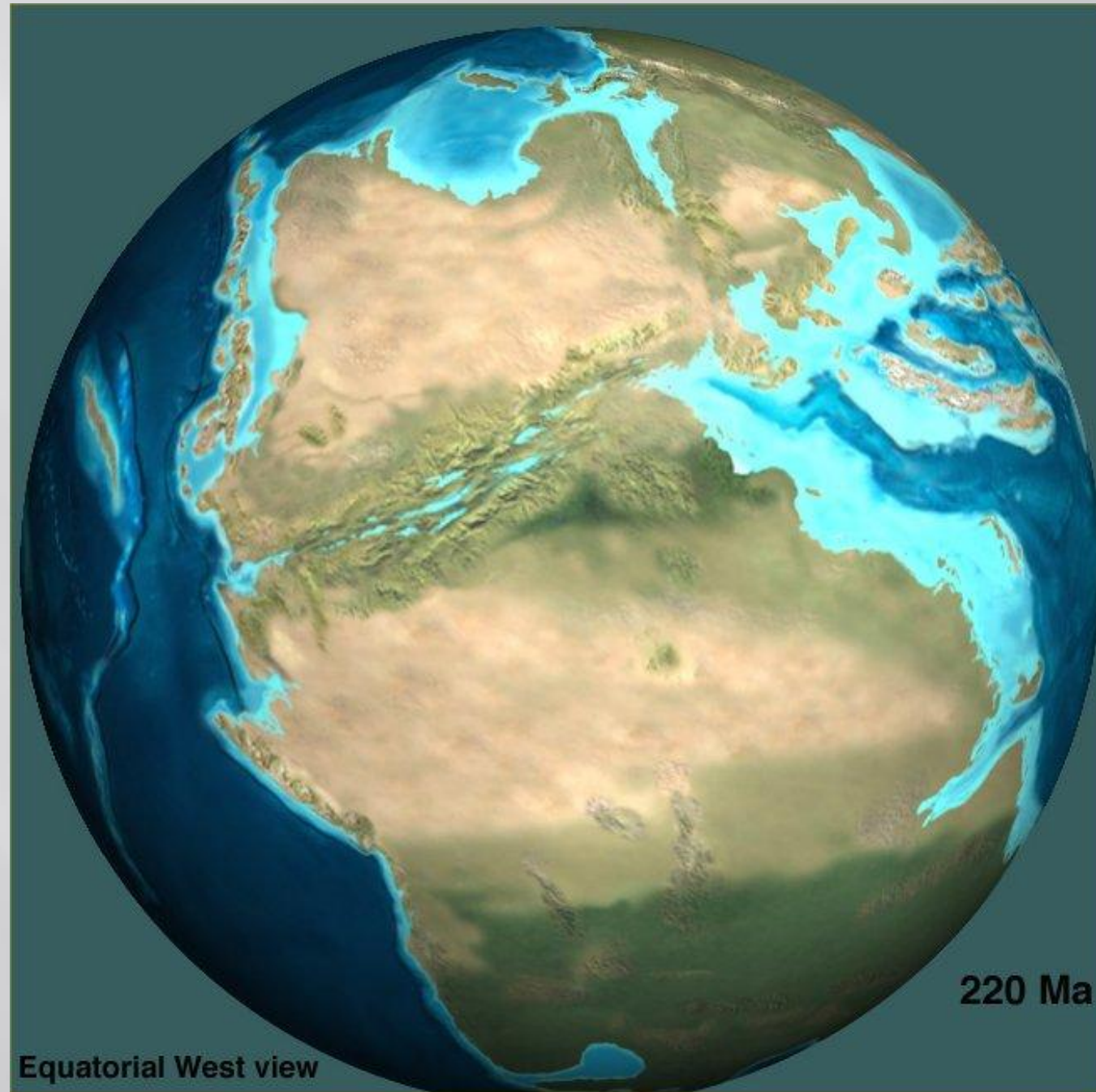


South Georgia Rift Basin (SGR) – Buried Mesozoic basin extending west-southwesterly from South Carolina into Georgia that formed along zones of faulting and subsidence during the period of crustal extension associated with the breakup of Pangea.

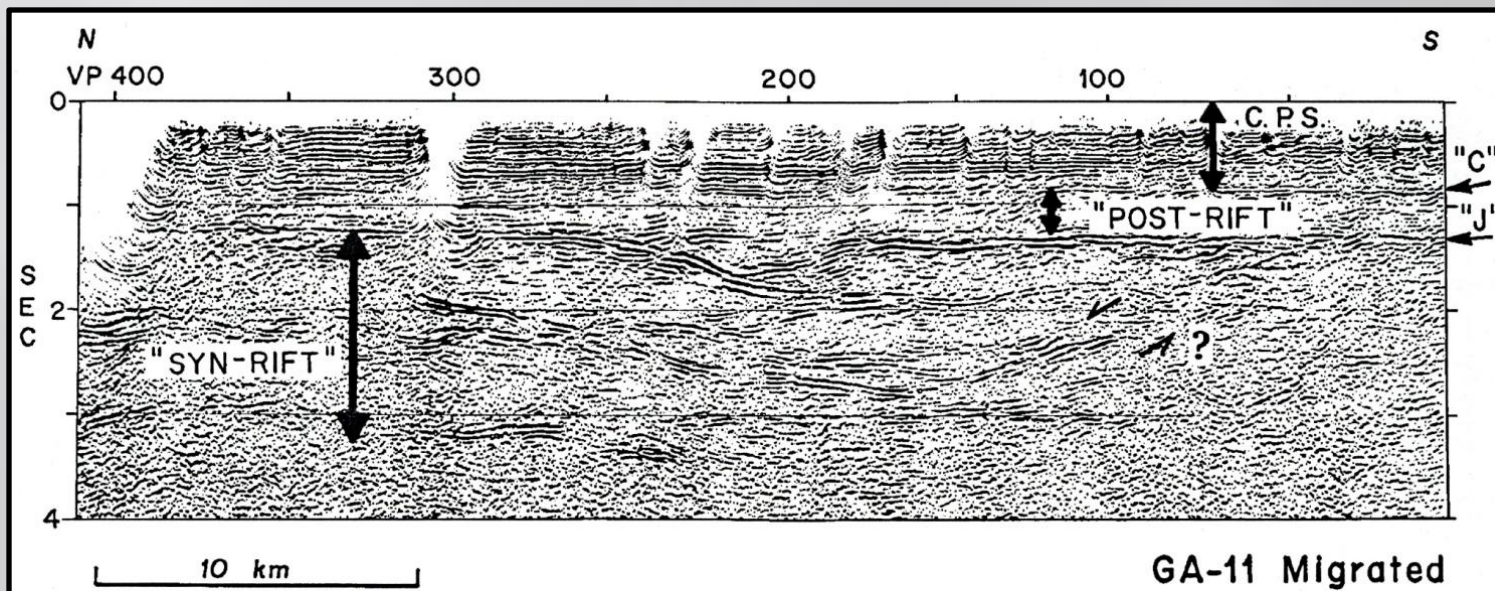
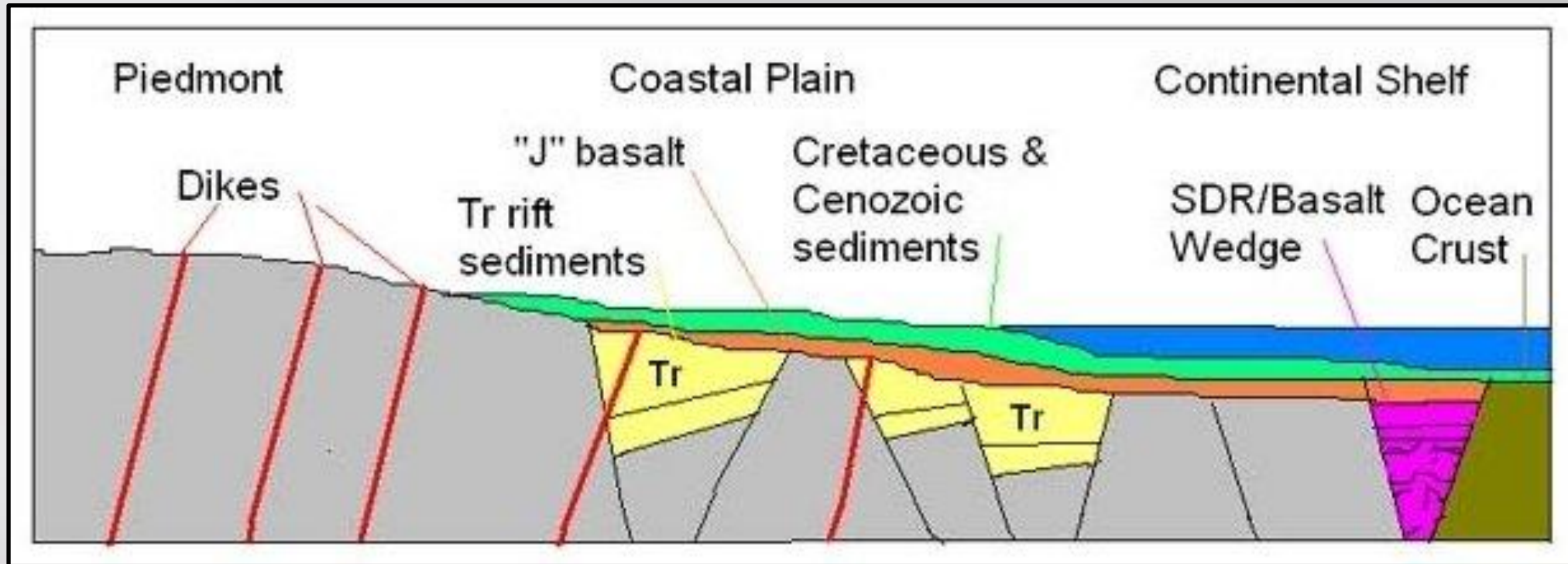


Triassic

- 250-202 Ma
- Pangea breakup



SGR Basin Description (cont'd)

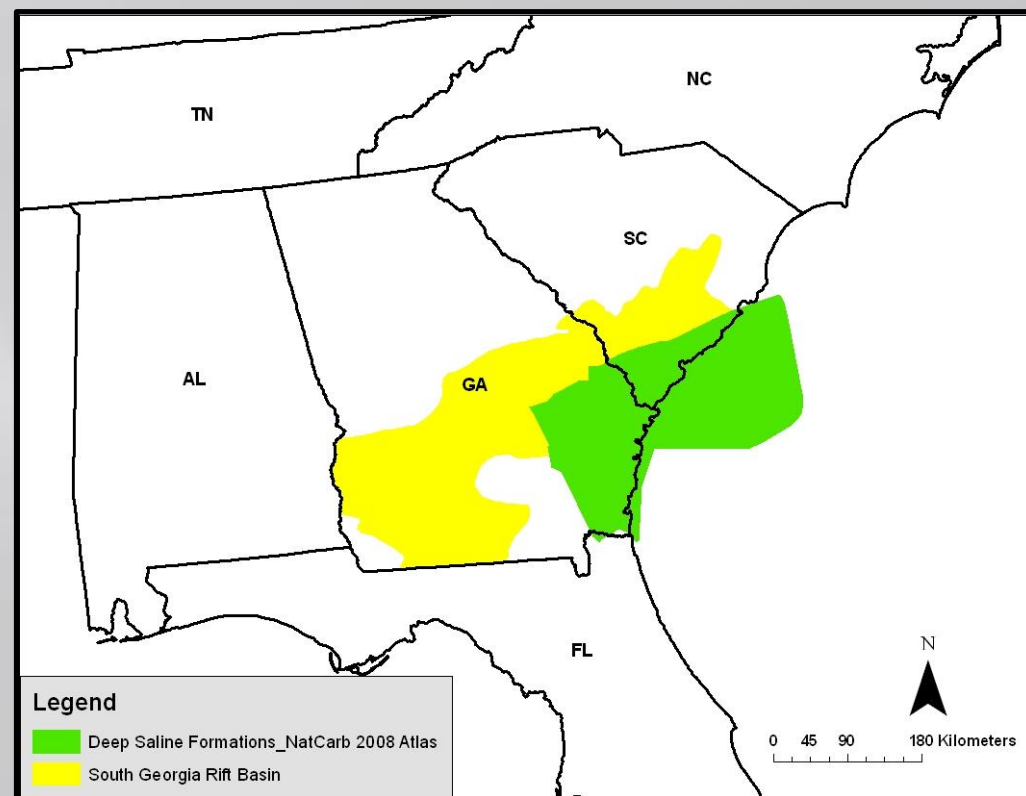


Continental Reflection Profiling (COCORP) line GA-11 located in southern Georgia from McBride, et al., 1989. This 1980's vintage seismic line images the base of the Coastal Plain sediments "C" and the post rift sediments and "J" Basalt extending into southern Georgia.

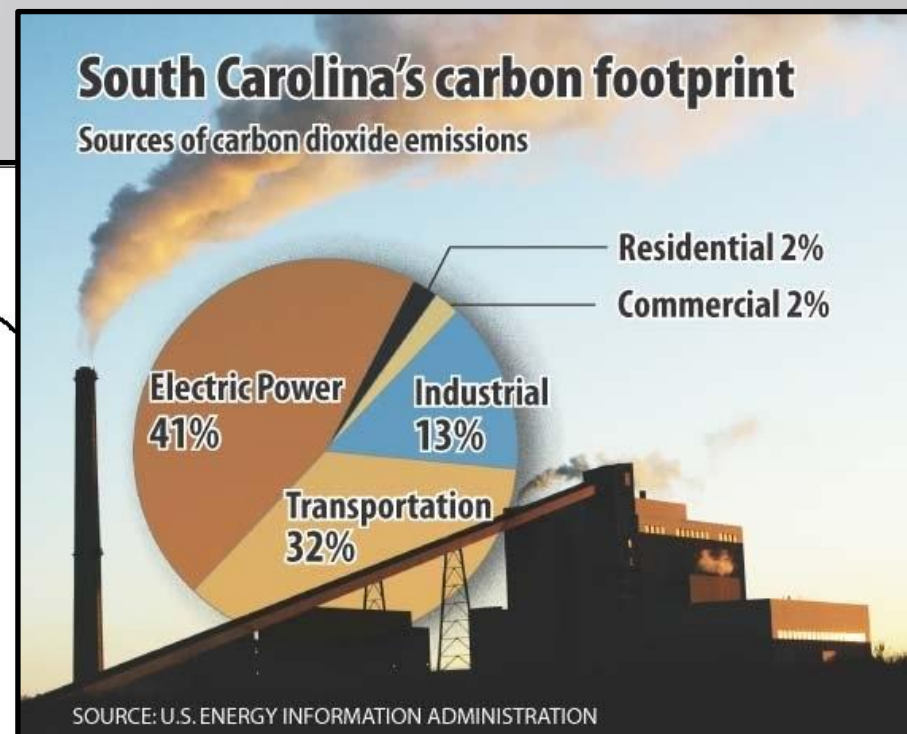
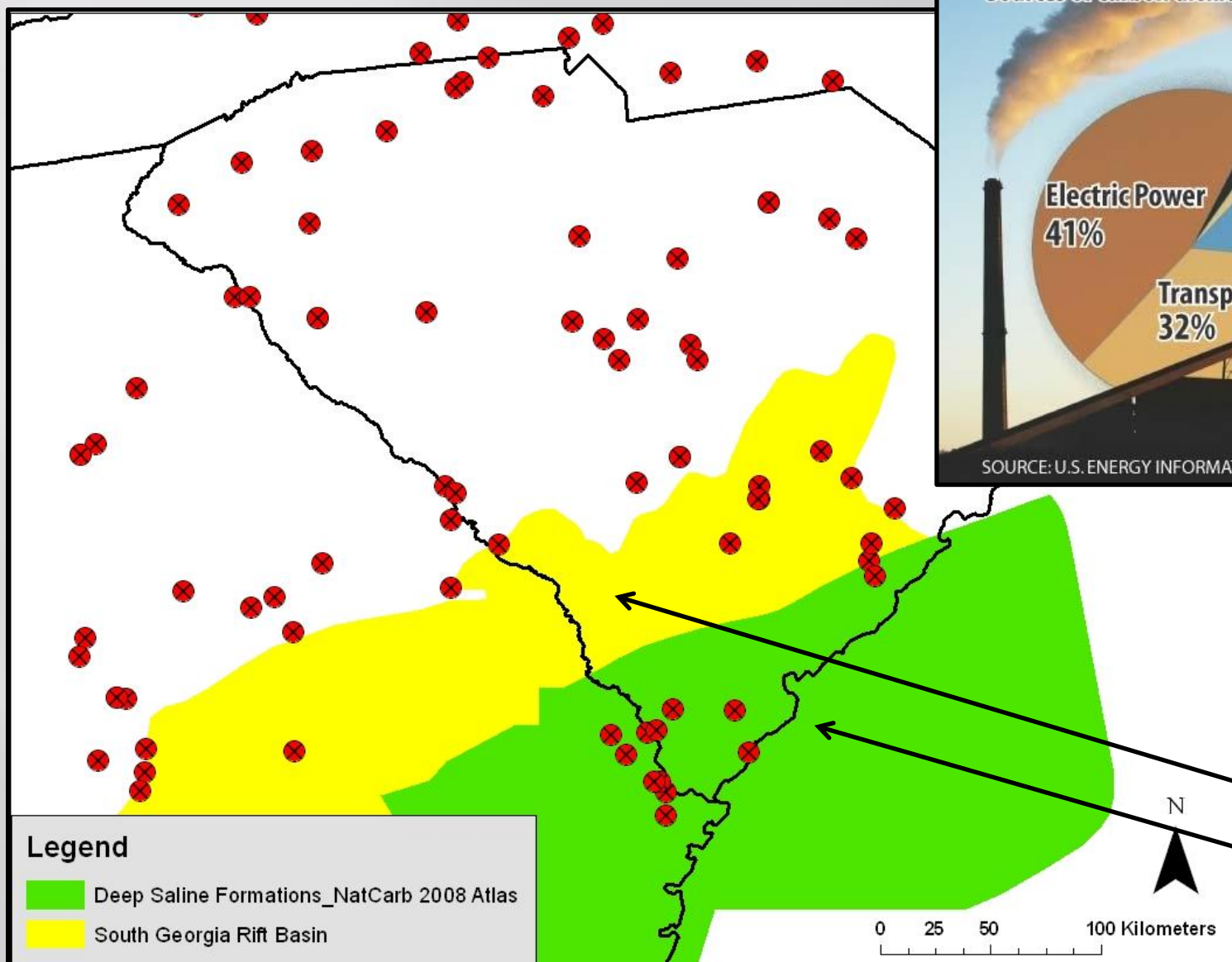


SGR Basin Description Overview

- Buried entirely beneath the Southeast Coastal Plain
- Covers area over 160,000 km²
- Thickness of the basin fill may be up to 6 km
- Basin fill mostly fine to coarse grained sandstones, conglomeritic sandstones, mudstones, and siltstones – redbeds with intercalated layers of basalt/diabase
- Partially overlain by Jurassic basalt (“J” horizon) that is up to 250 m thick in some parts of the basin



CO₂ Stationary Sources in South Carolina



Representations of the SGR Basin

Chowns and Williams, 1983

NatCarb Atlas, 2008



Geologic Characterization Hypothesis



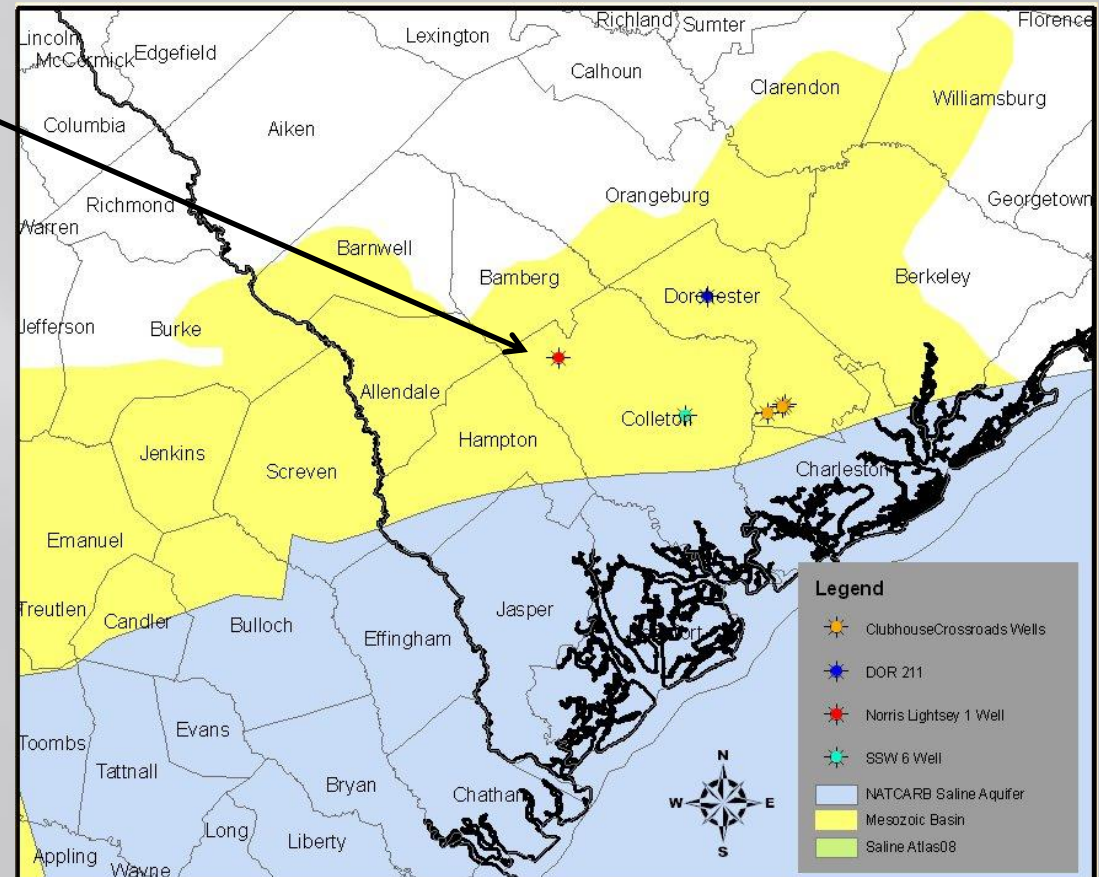
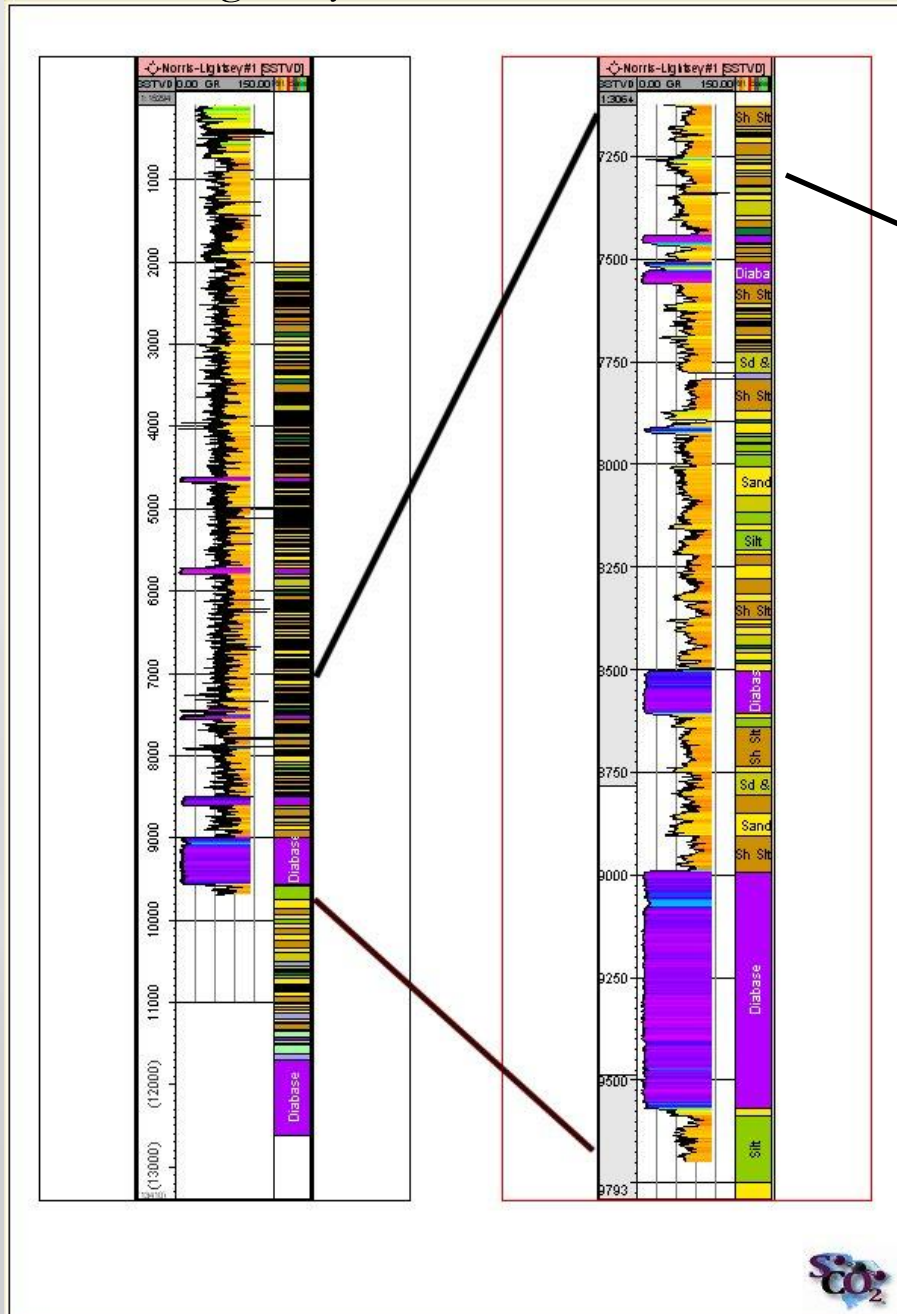
South Georgia Rift Basin is capable of storing large quantities of CO₂ and multiple caprock formations are present to maintain the integrity of the storage of CO₂ as a supercritical fluid.



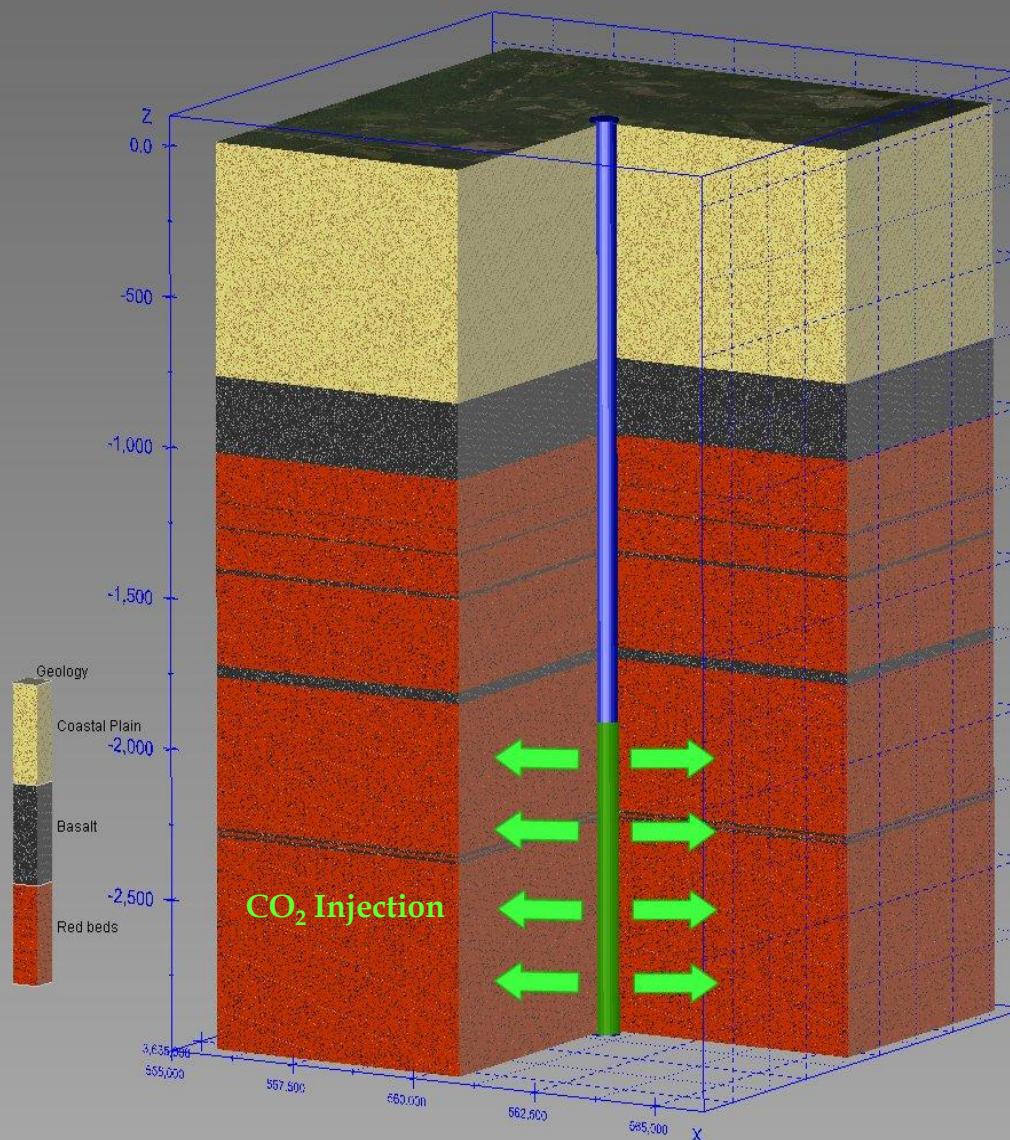
Preliminary Understanding of the Geology of the Study Area

(Based on sparse data)

Norris Lightsey No. 1



Initial Conceptual Solid Earth Model for SGR CO₂ Storage and Containment



South Georgia Rift Basin Characterization Approach

Three Phases Over Three Years

1. Preliminary geologic storage assessment based on existing data and analyses including re-interpretation and integration of existing data (Year 1)
2. Regional characterization of target CO₂ storage formation (Year 2)
3. Site-specific characterization via drilling, coring, logging geotechnical test hole (Year 3)

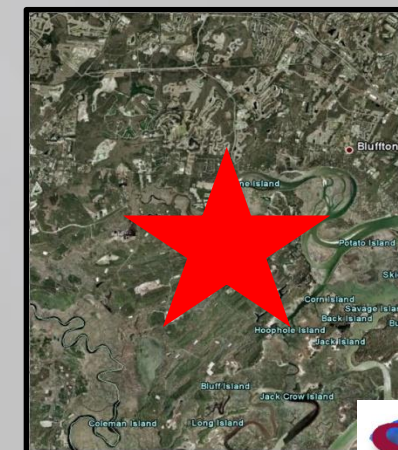
Phase 1



Phase 2



Phase 3

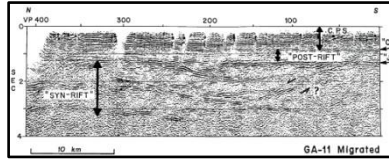


Spatial Scale Refinement



Phase 1 Initial Assessment Work Flow

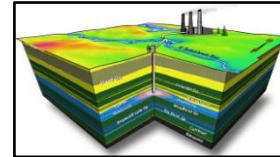
**Gather and Assess Existing
Geologic/Geophysical Data**



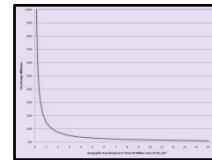
**Determine Structural Controls on
Mesozoic Reservoirs with Known Analogs**



**Identify Favorable Injection Zones
and Containment Effectiveness**



Estimate CO₂ Storage Capacity

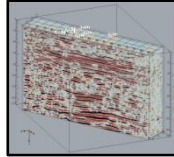


“Go/No Go” Decision

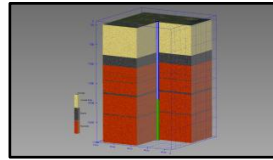


Phase 2 Data Integration and Solid Earth Modeling Work Flow

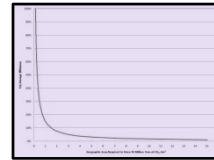
**Integrate New Seismic Data
with Phase 1 Existing Data**



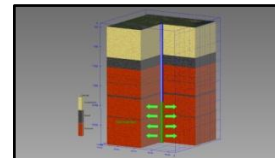
Refine Solid Earth Model



Update CO₂ Capacity Estimates



Simulate Injectivity into Formation



“Go/No Go” Decision



Phase 3 Site-Specific Characterization Work Flow

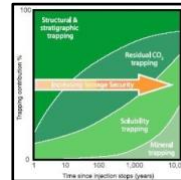
Drill/Log/Core Test Hole



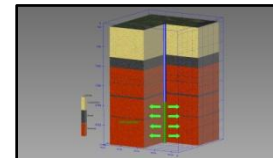
Assess Caprock and Storage Formation Properties and Brine Interaction



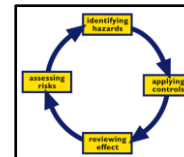
Evaluate Leakage Pathways



Finalize Conceptual Model of SGR and Simulate Injection

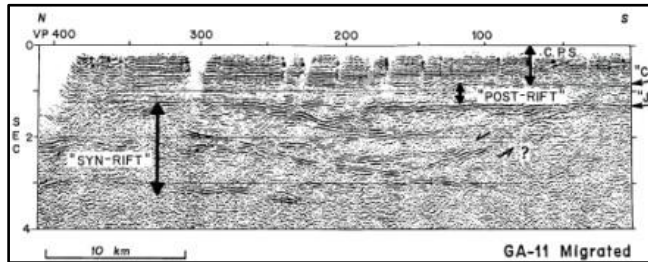


Identify Site Attributes that Pose Risks to Operations



Phase 1 Activities Underway

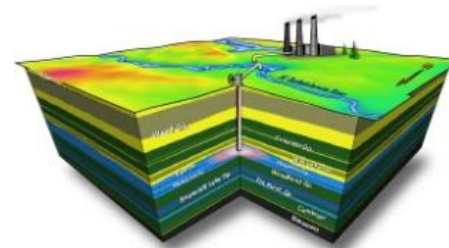
**Gather and Assess Existing
Geologic/Geophysical Data**



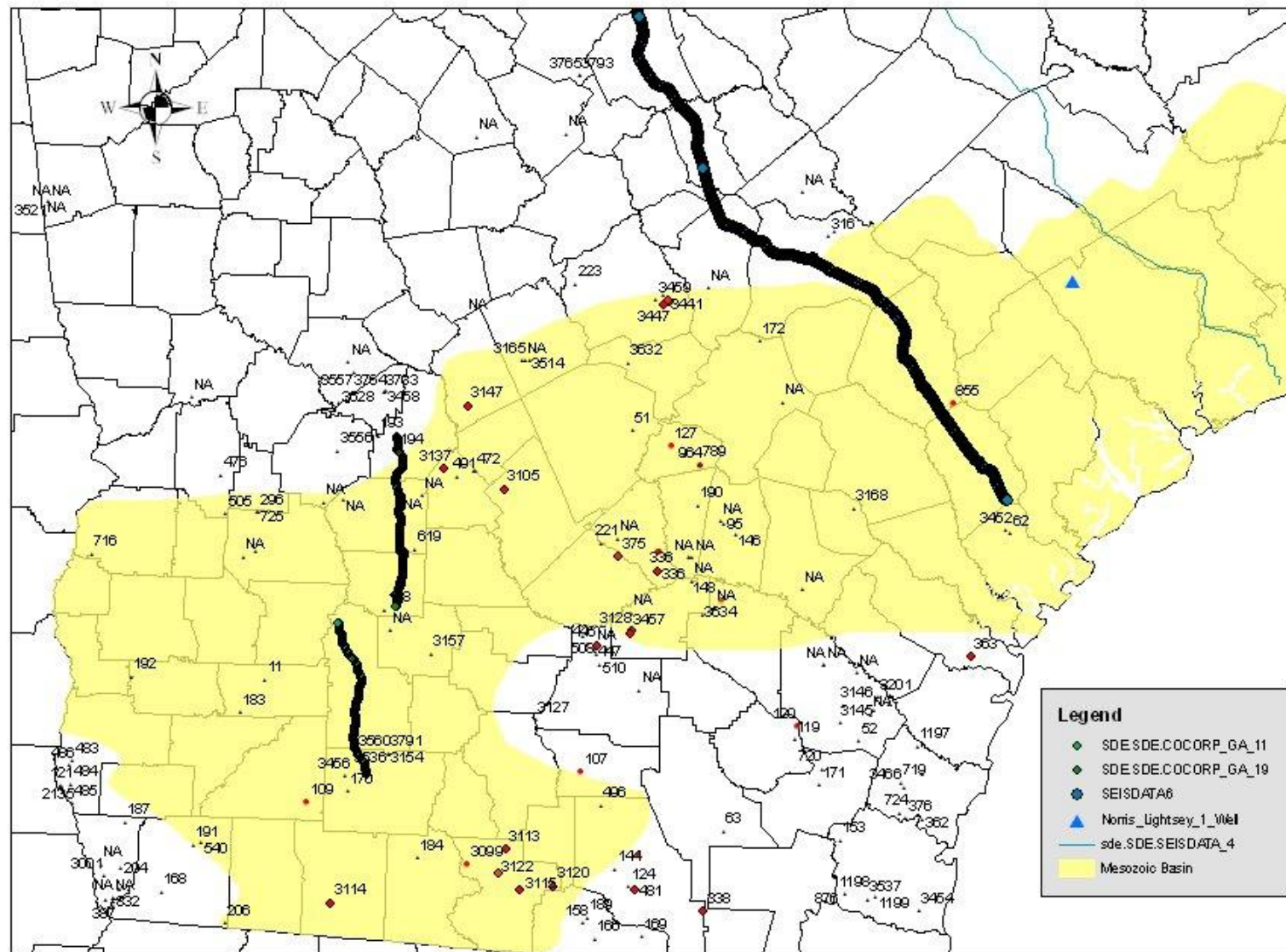
**Determine Structural Controls on
Mesozoic Reservoirs with Known Analogs**



**Identify Favorable Injection Zones
and Containment Effectiveness**



Partial List of Existing Data in Georgia

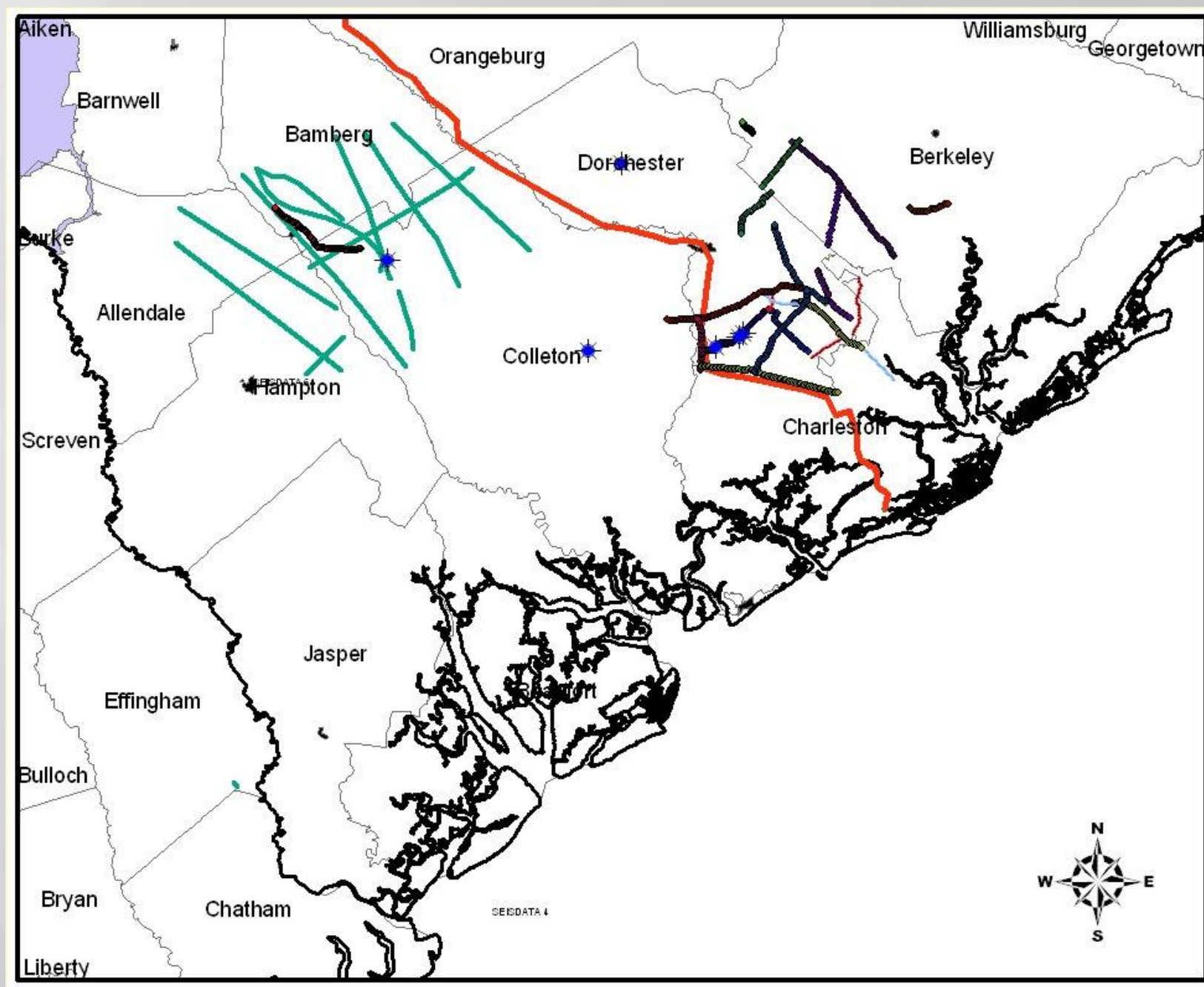


Labeled by GGS Number Labeled by Depth in Feet
Georgia Geological Survey

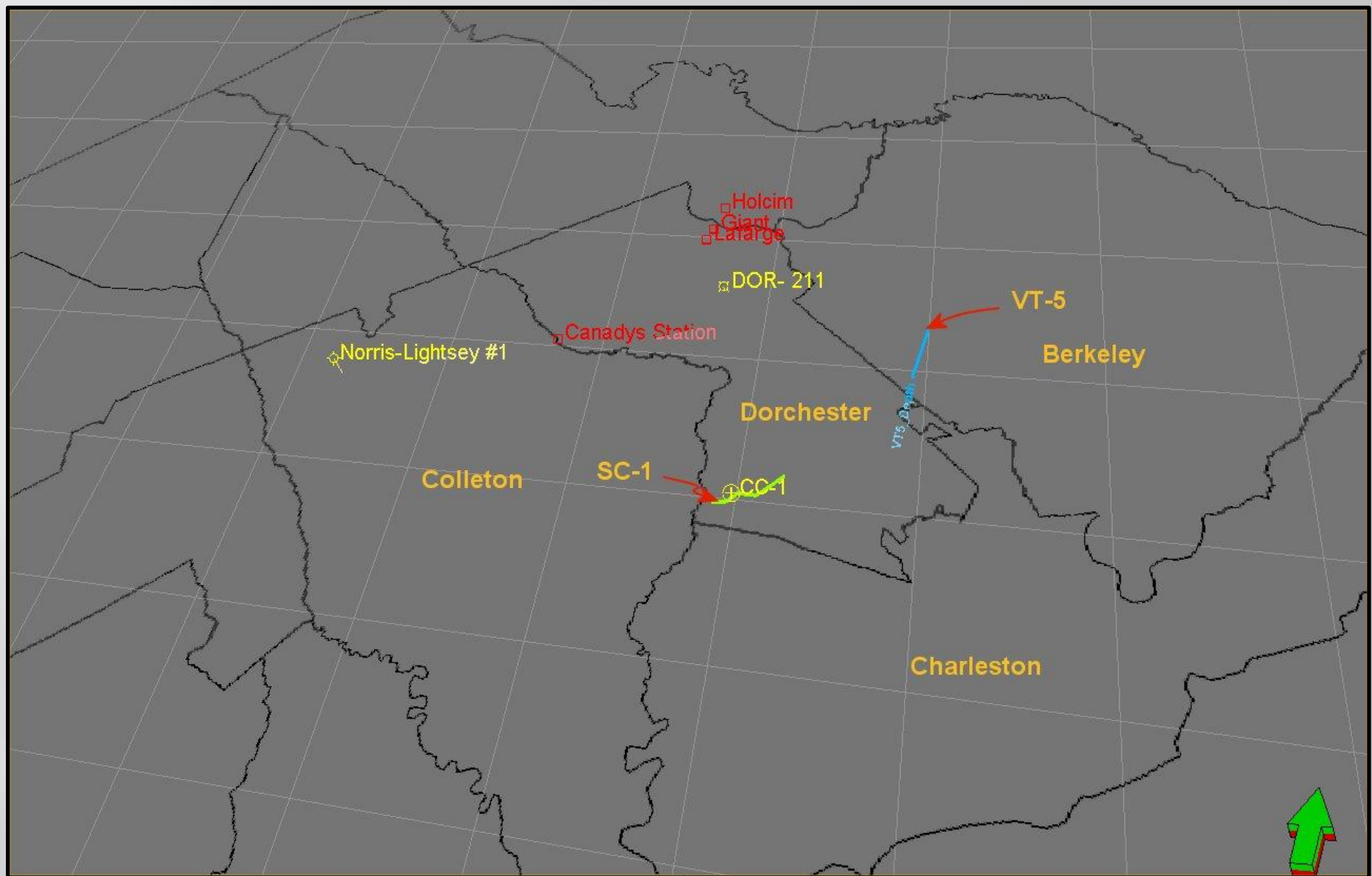
Red Dots Represent Wells with Scanned Logs
Green Triangles Represent Triassic Wells
Blue Triangles Represent Possible Triassic Wells



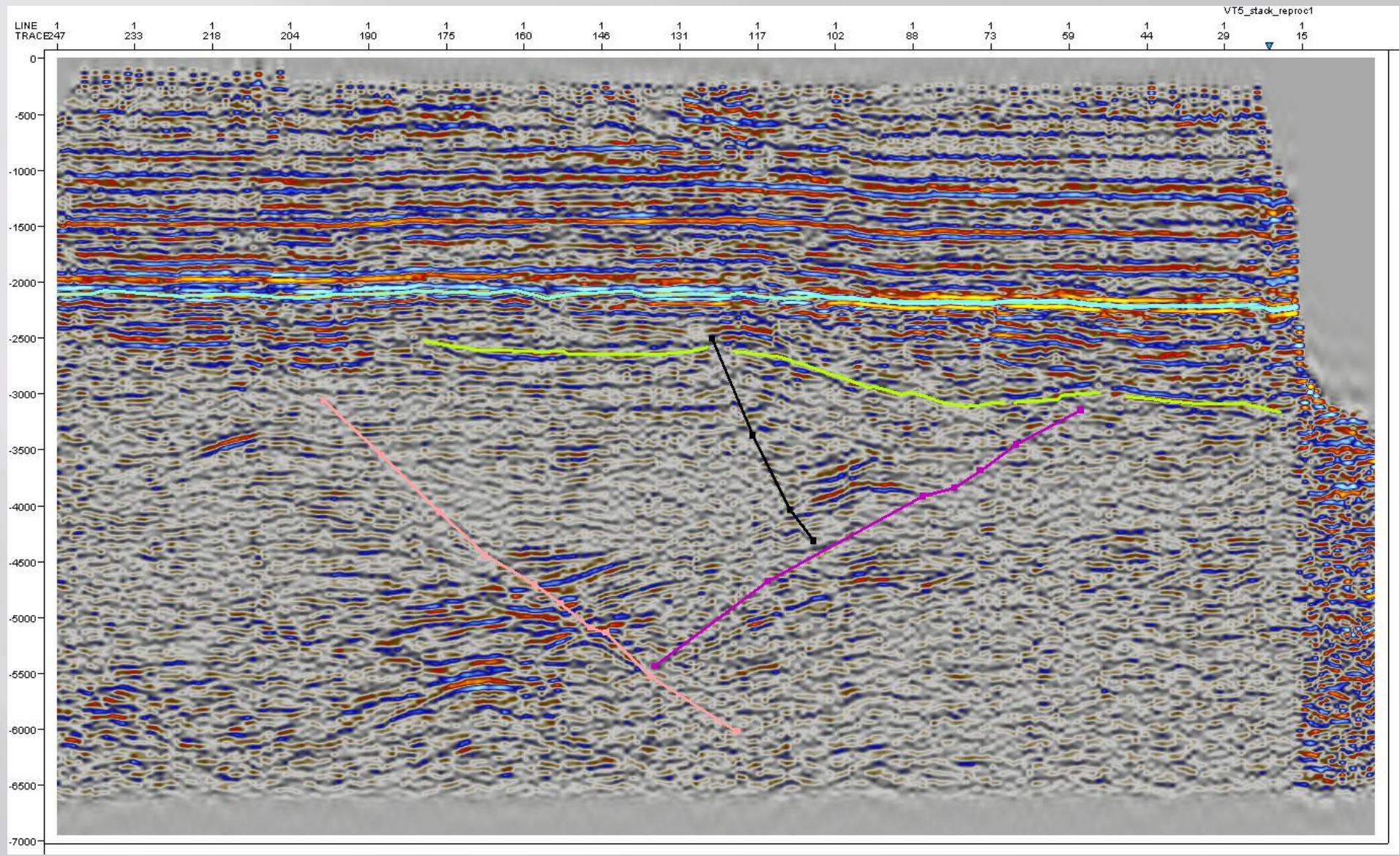
Existing Data in South Carolina



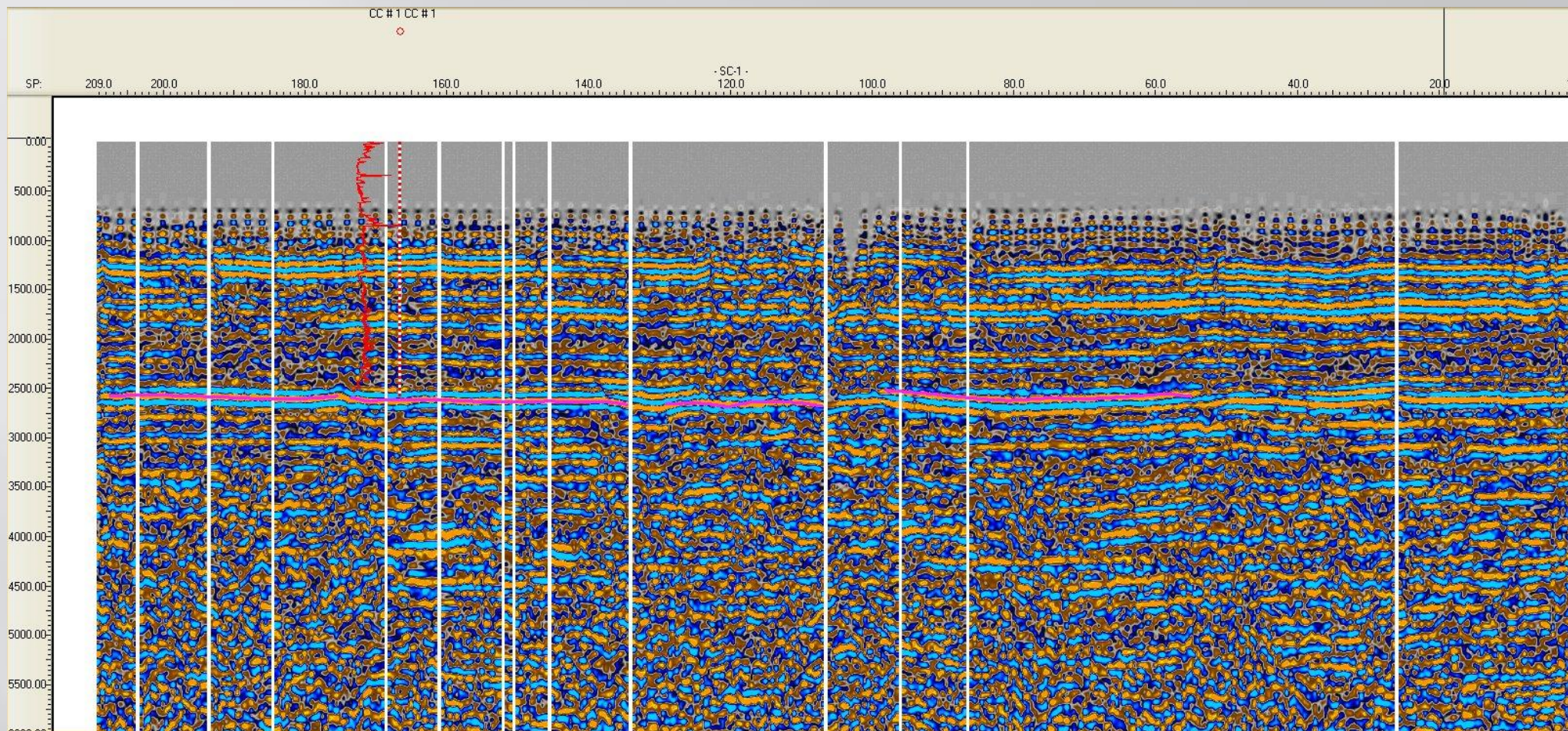
Examples of the Variable Seismic Data Quality



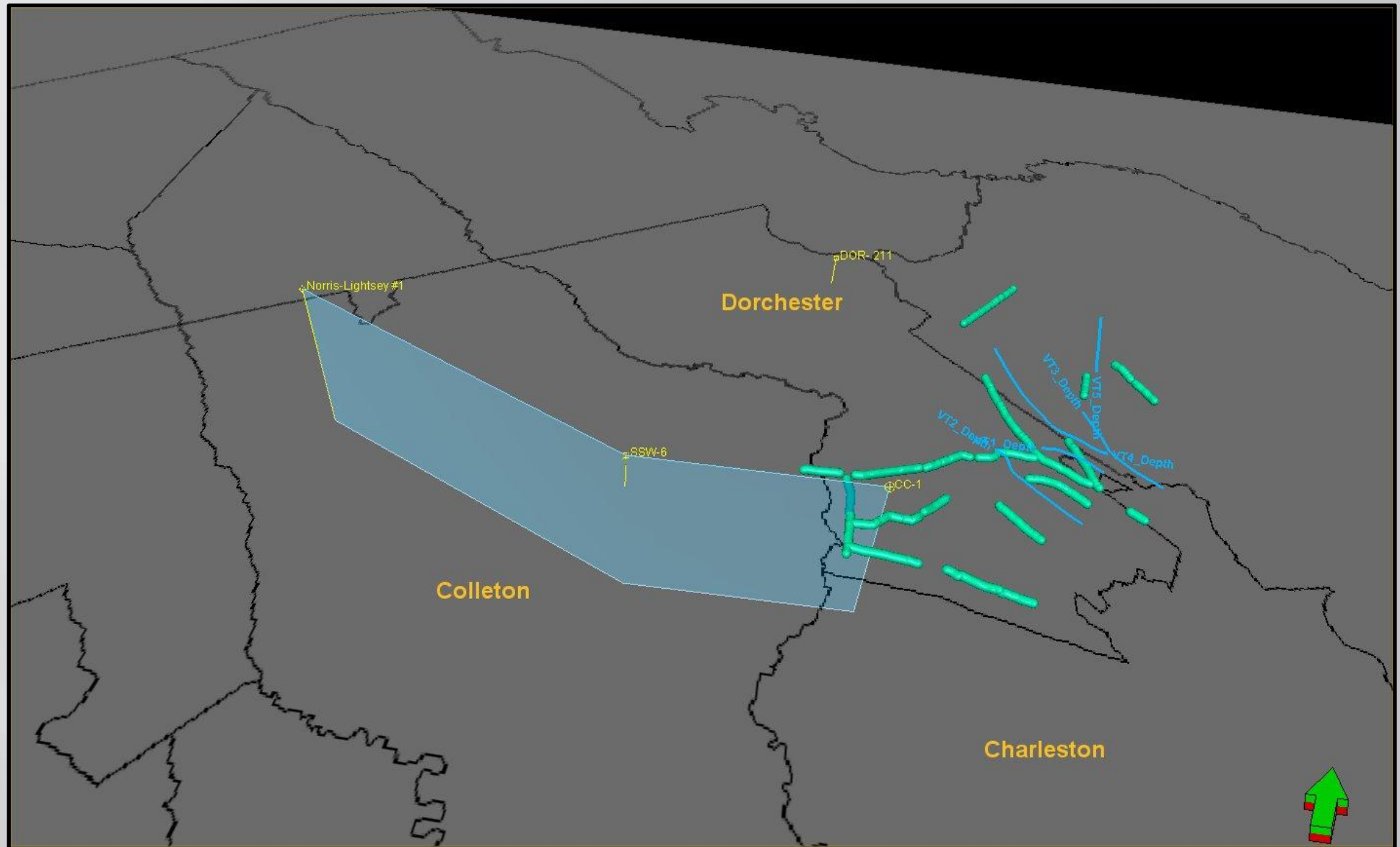
Seismic Line VT-5



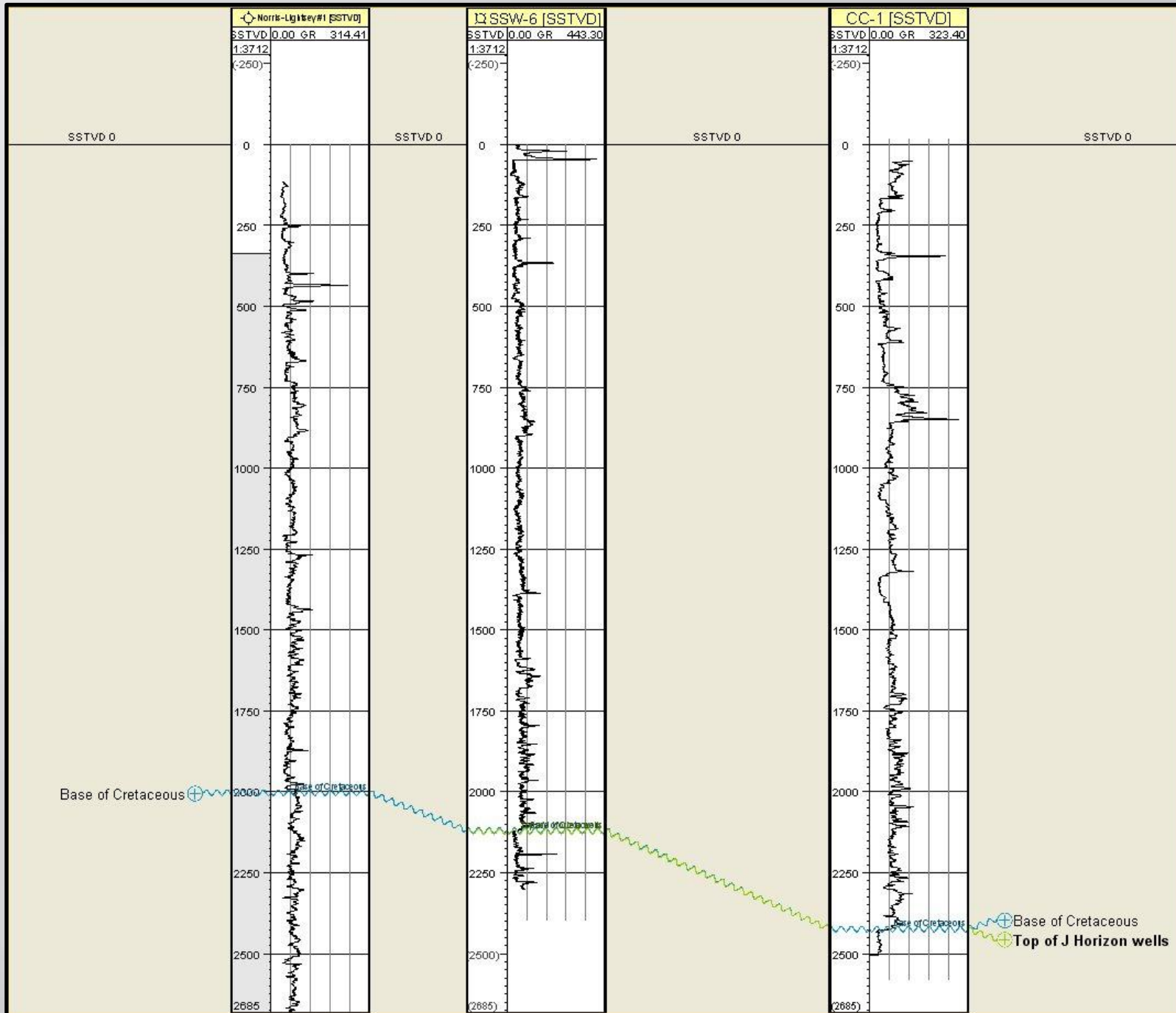
Seismic Line SC-2



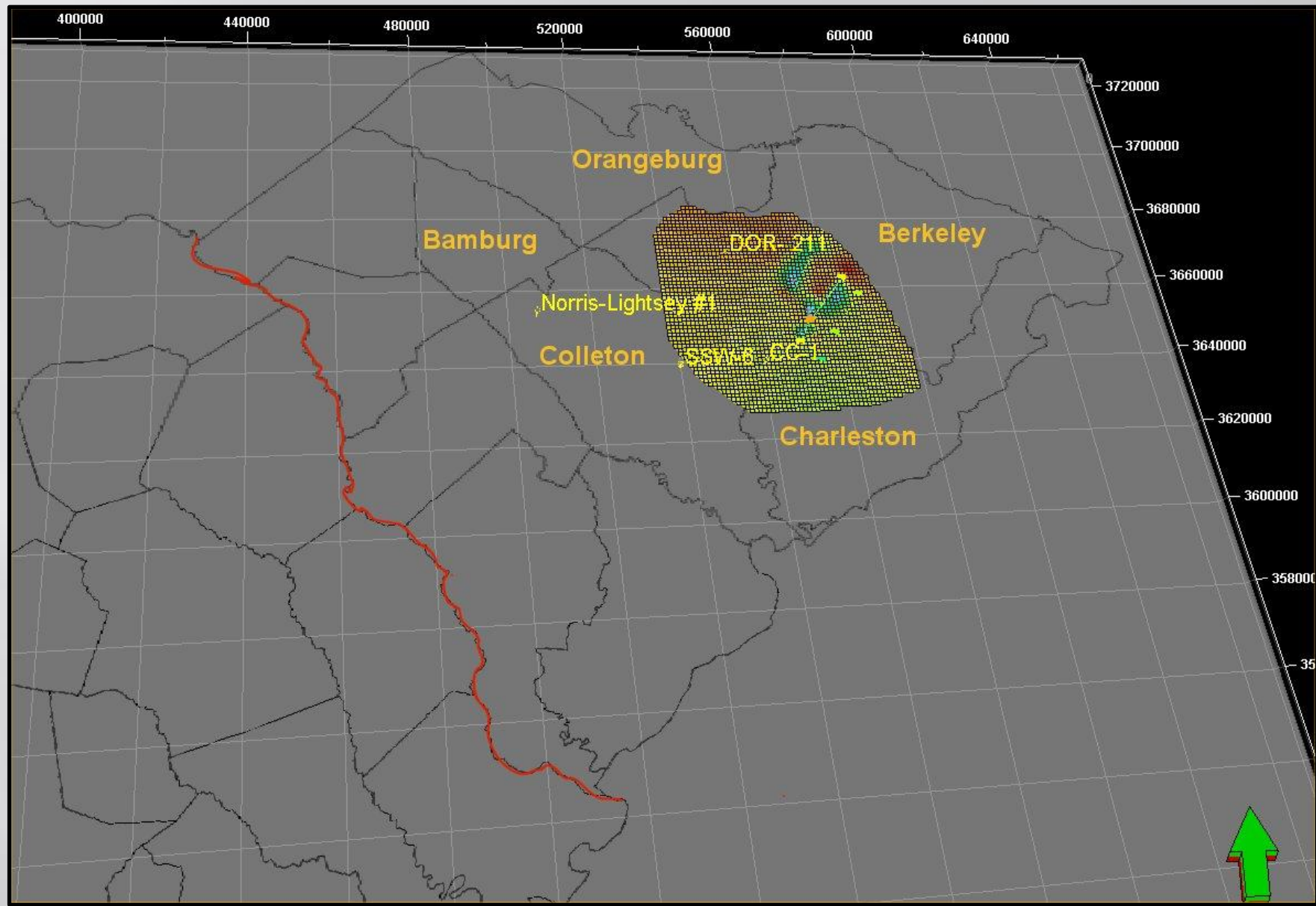
Determining Structural and Stratigraphic Controls



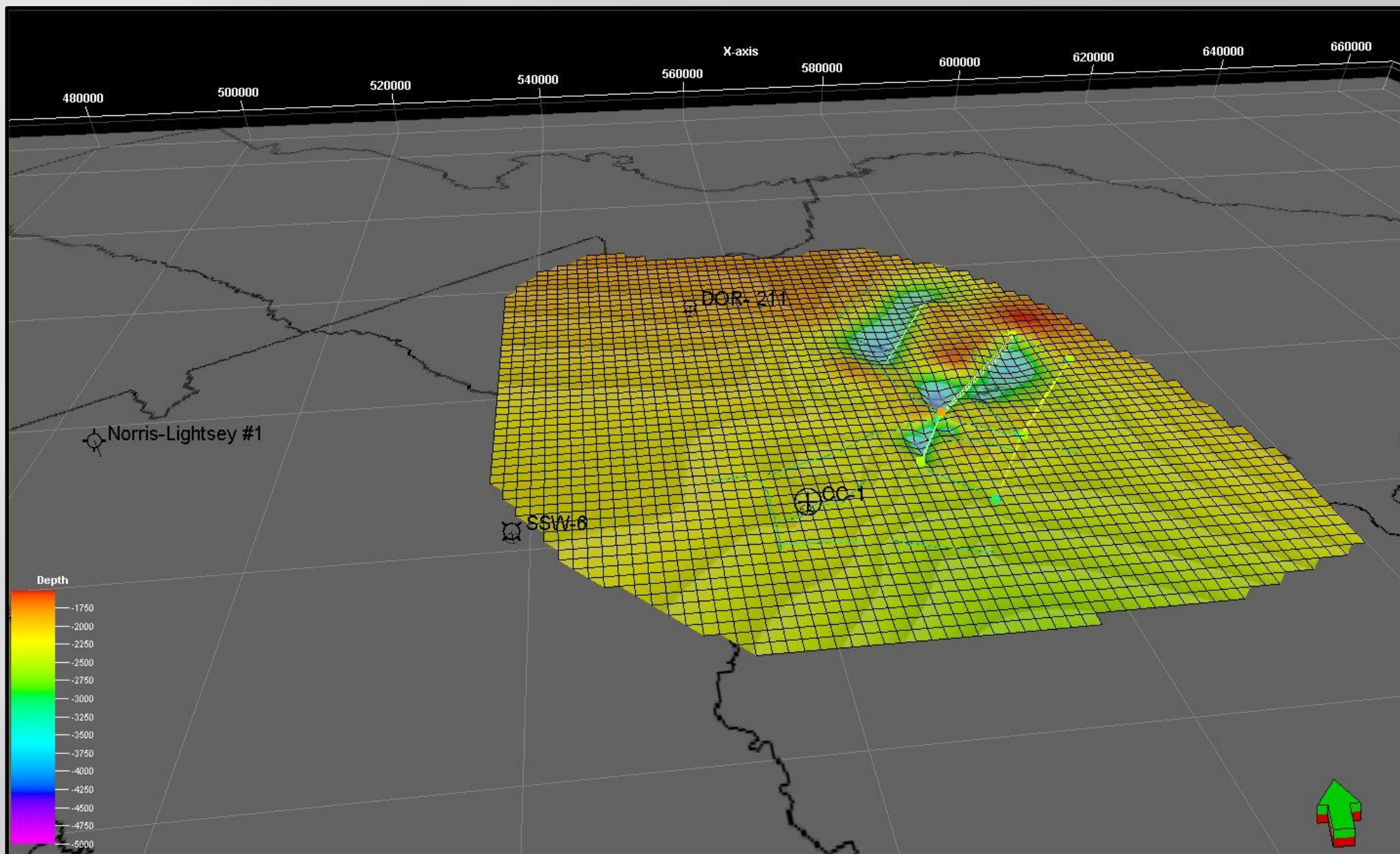
Determining Structural and Stratigraphic Controls



Phase 1: Preliminary Refinement of the Solid Earth Model

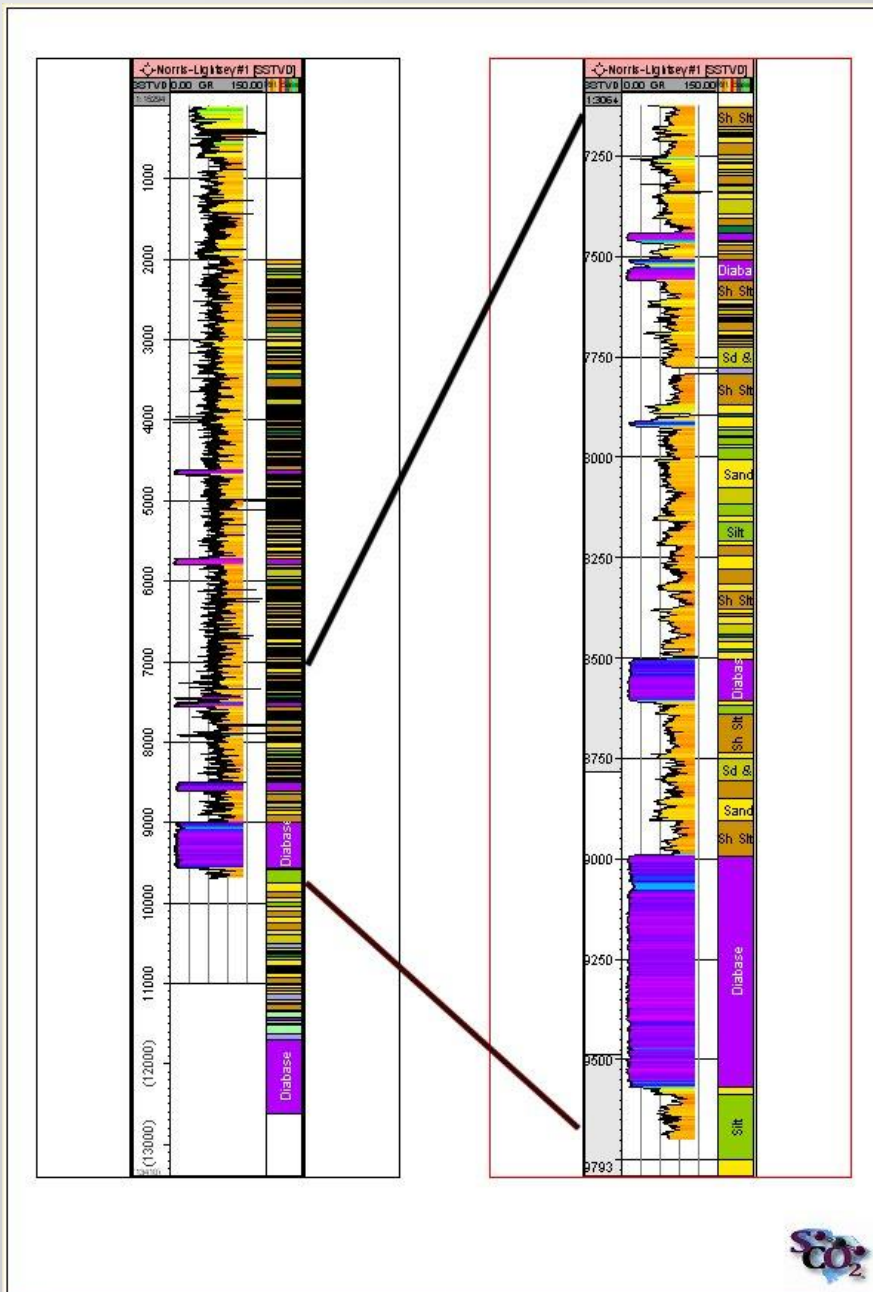


Top of the "J" Horizon

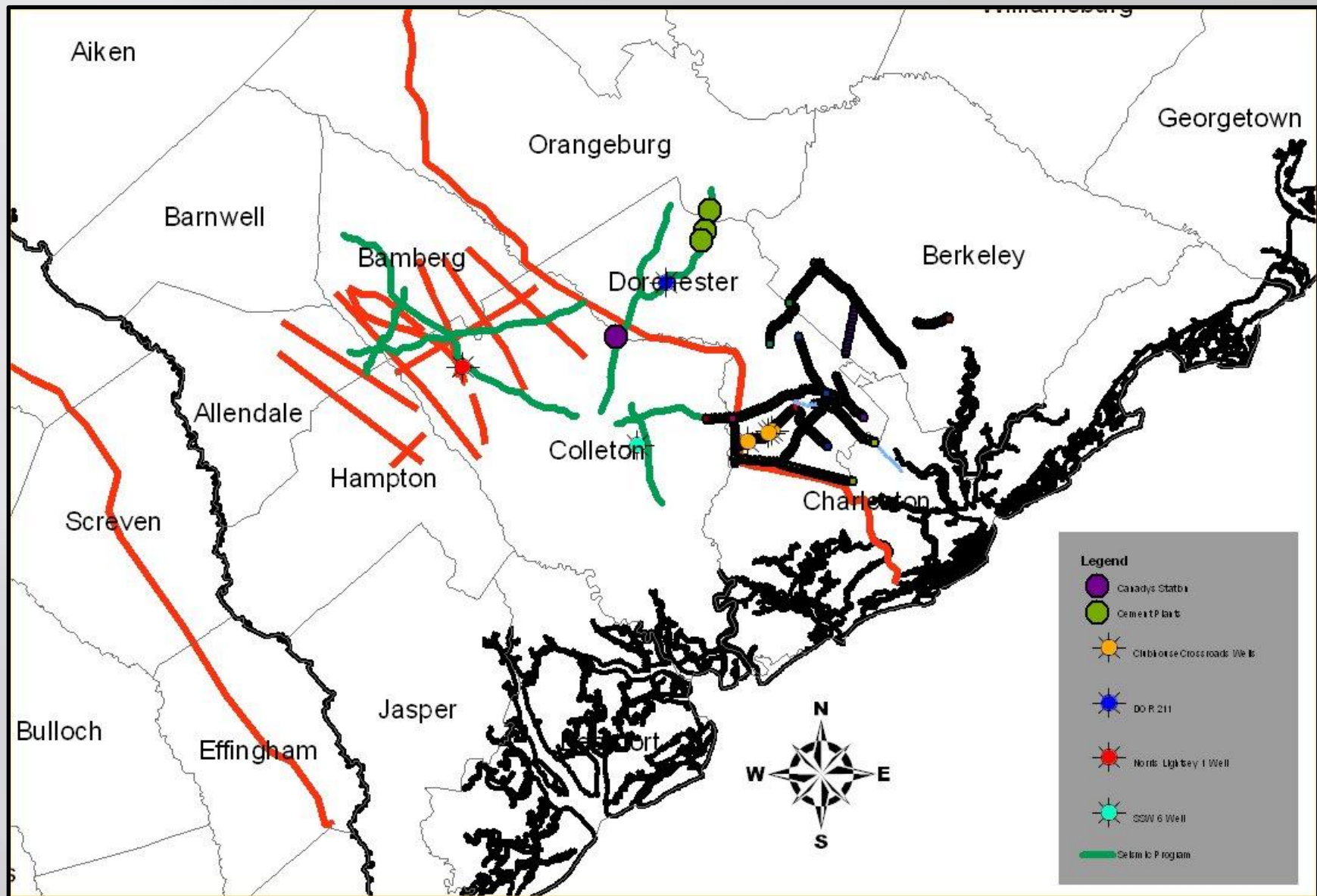


Phase 1: Assessing Potential Caprock and Reservoir Quality

Analogs from the Newark Basin?



Phase 2: Acquisition and Processing of Additional Seismic Data



Project Data Dissemination



Interface to NATCARB Database

Project Web Site to provide data, interpretations, educational materials, videos, and presentations that track the progress of our research and can be accessed and used by a broad audience.

www.dnr.sc.gov/SCO2

A screenshot of the University of South Carolina DNR website. The header includes the DNR logo and the University of South Carolina logo. The navigation bar has links for Home, Our Project, Information, and Resources. The main content area is titled "Geologic Characterization of the South Georgia Rift Basin for Source Proximal CO₂ Storage". It features a section about the U.S. Department of Energy, National Energy Technology Laboratory, and a map of the United States showing various CO₂ storage projects. A sidebar on the right titled "Geologic Carbon Sequestration" includes a diagram of a well and text about geologic sequestration and links to related resources.

Geologic Characterization of the South Georgia Rift Basin for Source Proximal CO₂ Storage

U.S. Department of Energy, National Energy Technology Laboratory

Carbon capture and storage, focused on curbing the increase in greenhouse gas emissions into the global atmosphere, is an emerging issue with governments and private industry around the world. Terrestrial and geologic sequestration of carbon dioxide (CO₂) are receiving considerable attention. As evidence of this interest, the University of South Carolina and its research partners, including the South Carolina Geological Survey, have received \$4,950,639 from the U.S. Department of Energy's National Energy Technology Laboratory for geologic characterization of the South Georgia Rift basin (SGRB) for source proximal CO₂ storage. This three year research effort is being led by the Earth Sciences and Resources Institute (ESRI-SC) and the Department of Earth and Ocean Sciences (EOS) at the university. Members of the research team, in addition to the South Carolina Geological Survey, are the University of Illinois, Weatherford Laboratories (Houston, TX), and Bay Geophysical, Inc. (Traverse City, MI).

Geologic Carbon Sequestration

Geologic sequestration is the underground storage of CO₂ in existing geologic formations. The following six types of repositories provide the best opportunities for permanent sequestration: 1) oil reservoirs 2) natural gas deposits 3) unmineable coal seams 4) deep saline formations 5) shale rich in oil or gas 6) basalt formations.

All sequestration techniques involve extensive monitoring, mitigation and verification (MMV) and continuous risk assessment of the site. Effective application of proper MMV procedures will ensure the safety of carbon sequestration techniques with regards to human and environmental health.

-The above graphic and information from University of Utah Carbon Science & Engineering Research Group

Links

[USC Earth Sciences and Resources Institute \(ESRI-SC\)](#)
[Southeast Regional Carbon Sequestration Partnership \(SECARB\)](#)

The Department of Energy is funding 10 projects (see above map and note that the Michigan project was not).



Acknowledgment & Disclaimer

**This material is based upon work supported by the
Department of Energy under Award Number DE-FE0001965**

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Questions?

